MASTER OF SCIENCE
IN
ENGINEERING ACOUSTICS

ACOUSTIC CYMBAL TRANSDUCERS-DESIGN, HYDROSTATIC PRESSURE COMPENSATION, AND ACOUSTIC PRODUCERS

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Continuing U.S. Navy interest in the development of light-weight, low-volume, broadband, underwater acoustic projectors and receivers is the principal motivation for this research topic. Acoustic cymbal transducers, so named for their geometric similarity to the percussion instruments, are miniature "class V" flextensional transducers that consist of a piezoelectric ceramic drive element bonded to two opposing cymbal-shaped metal shells. Operating as mechanical transformers, the two metal shells convert the naturally large generative force of a piezoelectric ceramic in the radial mode into increased volume displacement at the metal shell surface to obtain usable source levels and sensitivities in a broad frequency range. The magnified displacement makes the acoustic cymbal element a potential alternative to acoustic transduction technologies presently used to generate and receive Navy sonar frequencies. Potential benefits to utilizing this technology are generating or receiving broadband sound, at sonar frequencies in a thin, low volume, conformable package. Applications of this technology have been limited because air-backed acoustic cymbal elements undergo degradation in performance when exposed to elevated hydrostatic pressure (i.e., deep ocean and extreme littoral water applications). This research shows that consistent and reliable acoustic performance can be achieved with cymbal-based transducers at hydrostatic pressures of interest to the Navy.

KEYWORDS: Acoustic Calibration, Underwater Acoustics, Underwater Sound, Transducer, Flextensional, Acoustic Cymbal, Broadband, USRD, APTF, Piezoelectric, Piezoceramic, Array Elements, Hydrostatic Pressure, Pressure Compensation, Sonar